Modem-Router Connection Guide

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Introduction

This document explains how to configure Cisco routers and access servers for external modems connected to asynchronous and AUX ports, and it explains how to configure the modem to operate properly when connected. Connection to a console port is addressed in this document, but only with reference to concepts, not actual installation practices.

Note: This document is **not** a reference for the Microcom or MICA modems used internally on the AS5200, AS5300, AS5800, Cisco 2600, or Cisco 3600 routers, nor is it a reference for synchronous modems, though there may be a number of similarities. This document is a reference for asynchronous modems only. While much of the information here may apply to synchronous modems, do not rely on it when configuring them.

Hardware and Software Versions

The information in this document is based on the software and hardware versions below.

- Cisco IOS® Software Releases 9.21 and later
- A modem that is V.34-capable (or better)

Note: Platforms that have reached End of Life status, such as ASMs, MSMs, CSMs, STS-10s or 500-CSs, are not addressed by this document.

Hardware Configuration

The first step in attaching a modem to a router is to install the hardware. The main concerns are which cables to use and why or why not to use the console port for a modem.

Cabling Issues

It is important to connect the modem to the router before configuring the modem to verify that communication between them is established. If the cabling is incorrect, the rest of the process will fail.

As a rule, external modems are built with a female data communications equipment (DCE) DB-25 port for connection to a controlling device such as a PC or a router. The following table will help you select the appropriate cables to make the connection between the router and the modem. The table also includes information on the required cabling and the types of physical ports on Cisco routers to which a modem can be connected.

Router Port	Examples of where found	Cabling Required
DB-25 DTE	Male DB-25 AUX on the Cisco 4000, 7000, 7200, and 7500.	Straight-through DB-25F -- DB25M RS-232 cable.
DB-25 DCE	Female DB-25 console port on the Cisco 4000 and 7000 series.	Null-modem DB-25M -- DB25M RS232 cable. A rolled RJ-45--RJ-45 with CAB-25AS-MMOD adapters on both ends will work.
DB-60	Sync/async interfaces. Cisco 1005, 1600s, and 2500s; network modules on the Cisco 2600, 3600, and 4000.	Cisco-specific cable, the CAB-232MT(=).
RJ-45	AUX or CON on the Cisco 2500s, 2600, 3600, AS5200, and AS5300.	Rolled RJ-45--RJ-45 cable with adapter marked "MODEM" (part number CAB-25AS-MMOD).

68-pin	Cisco 2509-2512; network modules on the Cisco 2600 and 3600.	Cisco parts CAB-OCTAL-ASYNC(=) (with connectors marked "MODEM") and CAB-OCTAL-MODEM(=).
"Smart Serial"	WAN interface card (WIC) on 1720 and 2600s.	Cisco part CAB-SS-232MT(=).

Note 1: Sync/async interfaces require the **physical-layer async** configuration command in order to operate in asynchronous mode.

Note 2: The Cisco 1005 requires the IP/ASYNC or the IP/IPX/ASYNC feature set of Cisco IOS Software in order to allow asynchronous mode on its Serial interface.

Console Port Issues

There are several advantages to connecting a modem to the console port of a router instead of the AUX port; however, the disadvantages are significant.

Advantages of connecting a modem on the console port:

- Passwords can be recovered remotely. You may still need someone on-site with the router to toggle the power, but aside from that, it's identical to being there with the router.
- It is a convenient method of attaching a second modem to a router without async ports. This is beneficial if you need to access the router for configuration or management while leaving the AUX port free for dial-on-demand routing (DDR).
- Some routers (for example, Cisco 1600s) do not have AUX ports. If you want to connect a modem to the router and leave the serial port(s) free for other connections, the console is the only option.

Disadvantages of connecting a modem on the console port:

- The console port does not support RS232 modem control (data set ready/Data Carrier Detect (DSR/DCD), data terminal ready (DTR)). Therefore, when the EXEC session terminates (**logout**), the modem connection will not drop automatically; the user will need to manually disconnect the session.
- More seriously, if the modem connection should drop, the EXEC session will not automatically reset. This can present a security hole, in that a subsequent call into that modem will be able to access the console without entering a password. The hole can be made smaller by setting a tight **exec-timeout** on the line. However, if security is important, it is recommended to use a modem that can provide a password prompt.
- Unlike other async lines, the console port does not support hardware (Clear to Send/Ready to Send (CTS/RTS) flow control. It is recommended to use no flow control. If data overruns are encountered, however, software (XON/XOFF) flow control may be enabled.
- The console ports on most systems only support speeds of up to 9600 bps.
- The console port lacks reverse telnet capability. If the modem loses its stored initialization string, the only remedy is to physically disconnect the modem from the router and attach it to another device

(such as an AUX port or a PC) to reinitialize. If a modem on an AUX port loses its initialization string, you can use reverse telnet remotely to correct the problem.

- A console port cannot be used for dial-on-demand routing; it has no corresponding async interface.

Note: The remainder of this document addresses non-console connections.

Line Configuration

It is essential that the TTY line be configured **before** configuring/initializing the modem itself. The two main reasons are:

- To allow reverse telnet access to the modem.
- If you change the line speed after the modem has been initialized, the modem will no longer communicate with the router until it is again told at what speed to talk to the router.

In general, the following line configuration works best:

line "x"	TTY #. AUX port is line 1 on the router, last_tty+1 on the access server, line 65 on the Cisco 2600s and 3620, and line 129 on the Cisco 3640.
speed "xxxxx"	Set to the highest speed in common between the modem and the port. This value is usually 115200 baud, but see the Bitrate Information.
stopbits 1	Improve throughput by reducing async framing overhead (default is **stopbits 2**).
flowcontrol hardware	RTS/CTS flow control.
modem inout	Drop connection on loss of DCD (DSR). Cycle DTR for connection close. This command also allows outbound connections to the modem.
transport input all | telnet	Allow outbound connections to this line. Needed in order to allow reverse telnet to the modem.

This configuration assumes that the modem will always talk to us at "speed" (which is why you must LOCK SPEED on the modem), that the CD lead of the modem reflects the actual state of the carrier, and that the modem will hang up when the router drops DTR. Avoid substituting **autobaud** for **speed** if at all possible; it usually results in lower throughput.

Bitrate Information

Maximum Speed	Supporting platforms and interfaces
38400	Most AUX ports

115200	Cisco 1005, 1600, and 2509 through 2512 AUX on Cisco 2600 and 3600 Modules and WICs that support external asynchronous modems (for example, NM-16A, WIC-2A/S)

Note: If you are **routing** over the AUX port, notice that each character generates a processor interrupt. Abnormally high CPU utilization may be resolved by using a lower AUX port speed.

Modem Configuration

We recommend using the **modem autoconfigure type <*modemcap_name*>** command (introduced in Cisco IOS Software Release 11.1), to configure modems attached to async lines. If you are using a version of Cisco IOS Software earlier than 11.1, **script startup** and **script reset** can be used to configure the modems via a chat script.

For most applications, a modern modem should be configured as follows:

- Reset to factory defaults (use a hardware flow control template if possible).
- Use hardware (RTS/CTS) flow control.
- Use normal modem control (hang up on DTR drop; drop DCD on carrier drop).
- Enable, but do not require, error control (LAP-M [V.42] and MNP).
- Enable, but do not require, data compression (V.42bis).
- Enable all modulations supported by the modem.
- Lock DTE speed at the highest rate supported by both the modem and the async line.
- Enable autoanswer if needed; when in autoanswer mode, ignore the escape sequence (+++).

For details on the command set used by your modem, consult the documentation provided by your vendor or see the www.56k.com page for a list of links to this documentation.

Using Modemcaps and `modem autoconfigure`

Cisco IOS Software maintains a set of built-in modemcaps for various internal and external modems. Here's an example modemcap from Cisco IOS Software Release 11.3(9)T:

```
router#show modemcap

default
codex_3260
usr_courier
usr_sportster
hayes_optima
global_village
viva
telebit_t3000
microcom_hdms
microcom_server
nec_v34
nec_v110
```

```
nec_piafs
cisco_v110
mica
```

If you think one of these built-in modemcaps might be suitable, you can use the **modem autoconfigure type <*modem_name*>** or the **modem autoconfigure discovery** command:

```
async-1#terminal monitor
async-1#debug confmodem
Modem Configuration Database debugging is on
async-1#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
async-1(config)#line 1
async-1(config-line)#modem autoconfigure discovery
async-1(config-line)#

*Mar 3 03:02:19.535: TTY1: detection speed (38400) response ---OK---
*Mar 3 03:02:24.727: TTY1: Modem type is default
*Mar 3 03:02:24.731: TTY1: Modem command: --AT&F&C1&D2S0=1H0--
*Mar 3 03:02:25.259: TTY1: Modem configuration succeeded
*Mar 3 03:02:25.259: TTY1: Detected modem speed 38400
*Mar 3 03:02:25.259: TTY1: Done with modem configuration
```

Note 1: The built-in modemcap **mica** simply consists of an **&F**, and may be used with many modems to reset to factory defaults.

Note 2: Cisco does not warrant the suitability or currentness of the built-in modemcaps for non-Cisco modems.

You can also define your own modemcap and use the **modem autoconfigure type** command:

```
async-1#terminal monitor
async-1#debug confmodem
Modem Configuration Database debugging is on
async-1#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
async-1(config)#modemcap edit MyTest misc &FS0=1
async-1(config)#line 1
async-1(config-line)#modem autoconfigure type MyTest
async-1(config-line)#

*Mar 3 03:06:30.931: TTY1: detection speed (38400) response ---OK---
*Mar 3 03:06:30.963: TTY1: Modem command: --AT&FS0=1--
*Mar 3 03:06:31.483: TTY1: Modem configuration succeeded
*Mar 3 03:06:31.487: TTY1: Detected modem speed 38400
*Mar 3 03:06:31.487: TTY1: Done with modem configuration
```

Creating a Modemcap

To define your own modemcap, use the global configuration command:

modemcap edit <*modemcap_name*> miscellaneous <*initialization string*>

The modemcap is applied to the line configuration with the command:

modem autoconfigure type <*modemcap_name*>

Some useful manufacturer-specific modem commands are given below.

Note 1: The initialization string in the **modemcap edit** command is entered **without** a preceding **AT** and **without** the terminating **&W**.

Note 2: The ***modemcap_name*** in the above commands should **not** be the same as one of the predefined entries listed by the **show modemcap** command.

Note 3: The initialization string should begin with the command to reset to defaults (typically **&F** or **&F1**).

Note 4: For this method to work, the modem must be configured with **echo** and **response** codes turned on. Modems usually come from the factory with these values set, but you may need to manually reverse telnet to the modem and issue the command to turn on echo and response. The usual command to do this is **ATE1Q0**. Check your modem documentation.

Creating a Chat Script

To configure a chat script for configuring a modem, use the global configuration command:

```
chat-script <script-name> AT OK "initialization string" OK
```

The chat script can be invoked manually for a single line with the command:

```
start-chat <script-name> <line-number>
```

The chat script can also be invoked automatically by adding the command below to the line configuration:

```
script startup <script-name>
script reset <script-name>
```

The chat script will be invoked every time the system reloads, the line resets at the termination of a session, or the line is cleared manually.

To verify that the chat script is functioning properly, use the **debug chat** command.

Note: For this method to work, the modem must be configured with **echo** and **response** codes turned on. Modems usually come from the factory with these values set, but you may need to manually reverse telnet to the modem and issue the command to turn on echo and response. The usual command to do this is **ATE1Q0**. Check your modem documentation.

Reverse Telnetting

To establish a reverse telnet connection, issue the following command:

```
telnet x.x.x.x 2yyy or [2000+yyy]
```

The ***x.x.x.x*** represents the IP address of any up/up interface on the Cisco router (for example, an Ethernet or Loopback) and ***yyy*** is the line number to which you want to connect. If the TTY line has already been configured, you can issue the **telnet** command from anywhere on the network that can ping the ***x.x.x.x*** interface.

Keep in mind that the AUX port of any router is the last async line number + 1. You can use the **show line** or **show line aux 0** command to see which line number this is.

If your connection is refused, this usually means that there is already a connection to that port, or there is an EXEC (prompt) running on that port. The cause could be that the modem failed to lower CD after a call disconnected, resulting in an EXEC that remains after the disconnect. In order to force the line back into an idle state, you can clear the line from the console to try again. If it still fails, make sure that you have set the **modem inout** and **transport input all | telnet** commands for that line. Also be sure that the modem is not set to override DTR (for example, as the USR modems can do with DIP switch settings). If you don't have modem control (as in pre-9.21 AUX ports), be sure to set the **no exec** command on the line before making a reverse connection. You can also try to configure the modem using an external terminal. As a last resort,

disconnect the modem, clear the line, make the telnet connection, and *then* attach the modem. This prevents a misconfigured modem from denying line access.

Always issue the initialization commands to the modem starting with **AT** and issue them at the speed at which you wish the modem to talk to the Cisco router. This ensures that the modem will always talk at the expected speed regardless of the speed of any incoming modem connection (assuming that you set the modem to lock on the DTE speed, which is **required**).

Caveats

- If your dialup EXEC connection appears to stop responding, enter **^U** (clear line) and **^Q** (XON), then press **Return** a few times.
- When you are dialed in, if you type **quit** and the modem does not hang up, then either it is not watching DTR, modem control was not configured properly on the Cisco router, or the cabling is incorrect.
- If you find yourself in someone else's session (that is, at an enable or a configure prompt) when you dial in, either the modem is not dropping CD on disconnect or you have not configured modem control on the Cisco router.
- If you issue a **+++** on the dialing modem followed by an **ATO** command and discover that your connection does not respond, the answering modem interpreted the **+++** when it was echoed to you. This is a bug in the answering modem and has been observed on many modems. There may be a switch to defeat that, but it varies from modem to modem.
- If you have **autoselect** turned on in the line configuration, a carriage return is required to get into EXEC.
- If you elect to do hardware (RTS/CTS) flow control (which is strongly recommended), make sure it is enabled on both the router/access server's line (DTE) and the modem (DCE). Having one on and the other one off will cause data loss.
- If you have an MDCE connector, turn it into an MMOD connector by moving pin 6 to pin 8, because most modems use CD and not DSR to indicate the presence of a carrier. If not, some modems can be programmed to provide carrier information via DSR.

Manufacturer-Specific Modem Initialization Commands

Recommended initialization strings are provided here for some common modems, but be aware that Cisco does not warrant that they are suitable or current. When in doubt, refer to the modem vendor's documentation or technical support.

Modem Brand	Initialization String	Notes

3Com/USRobotics	**&F1S0=1**	**&F1** factory hardware flow control defaults In addition to the initialization string, 3Com/USR modems require DIP switches to be properly set. Switches 3 and 8 must be **down** and all the rest must be **up**.
AT&T/Paradyne	**&FS0=1&C1&D3\Q3\N7%C1**	
Best Data Smart One	**&FS0=1&C1&D3**	
Diamond/Supra	**&FS0=1**	
Global Village	**&FS0=1&C1&D3\Q3\J0\N3%C1**	
Hayes Optima	**&FS0=1&Q9&C1&D3**	**Note:** Do not use the built-in **hayes_optima** modemcap. It sets **&Q6**, which disables error control.
Microcom	**&FS0=1&C1&D3\Q3\J0\N6%C1**	**Note:** This information is *not* intended for use with the internal modems found on the AS5200, Cisco 2600, or Cisco 3600 platforms. This information is intended for Microcom

		stand-alone modems.
Motorola ModemSurfr	**&FS0=1&C1&D3\J**	
Motorola/Codex	**&FS0=1&C1&D3*FL3*SC1*SM3*DC1**	
Multitech	**&FS0=1&C4&D3$SB115200**	**Tip for Multitech modems:** The DTE speed must be expressly declared with the **$SB** command. Set it to whatever line speed you have configured. Failure to do so will result in speed mismatches.

Related Information

- **Access-Dial Technical Tips**
- **Access-Dial Top Issues**
- **Access Products Support Page**
- **Access Technology Support Page**

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